Highlights
Environmental Management
Technology Innovation & Development

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

WHAT'S INSIDE

February 2011

Reducing the Cost of Closure with Better Science and Technology

The Department of Energy (DOE) Office of Technology Innovation and Development's (OTID) mission is to transform science into viable solutions for environmental cleanup. An Impact Plan outlining the benefits of an increased research and development budget on the life-cycle cost of cleanup across the DOE complex shows that OTID's investment in such a transformation could reap a potential 67:1 return on investment (ROI) over the next five years.

The Plan outlines how OTID could reduce the Office of Environmental Management's (EM's) >$250 billion life-cycle cost by $50 billion, with cost reductions in all areas of the technology program, including waste processing, groundwater and soil, nuclear materials and deactivation and decommissioning. The projected life-cycle costs and ROI are based on actual savings realized from technology innovation, development, and insertion for closure of the Fernald, Rocky Flats, Mound, and Ashtabula sites.

Also prepared in 2010, the EM Research and Development (R&D) Plan outlines specific research programs to accelerate completion of closure activities at EM sites.

In 2010 increased emphasis has been placed on integration, collaboration to achieve OTID goals, and communication. A rigorous peer review process to ensure that investments in high ROI, transformational, applied research has also been instituted. Through environmental leadership, OTID will reach out to the greater scientific community to incorporate the best and brightest ideas into the R&D program.

The Waste Processing Technical Exchange Fosters Collaboration

A record number of participants took part in the 2010 Waste Processing Technical Exchange, held in Atlanta on Nov. 16-18. This year's forum, sponsored by OTID's Office of Waste Processing and hosted by the Savannah River National Laboratory's (SRNL) EM Technical Integration Office, was the eighth such Technical Exchange and attracted 275+ participants from DOE and other government agencies, national laboratories, contractors, universities, and other technology providers to discuss accelerated waste cleanup and innovations at the Savannah River, Hanford, and Idaho sites.

Thirteen sessions featured 70 oral presentations and 45 posters. Topics included waste retrieval, waste form development, pretreatment, facility readiness and startup, performance assessment, tank farm operational improvements, and advanced stabilization. Key features of the Exchange were open discussions among operations, engineering, and science personnel, and sharing of lessons learned regarding ways to accelerate transition of technologies from concept to field deployment.

Yvette Collazo, Director of Office of Technology Innovation and Development.

The sessions were broadcast through live and on-demand web-casting, which permitted another estimated 100 viewers to participate and submit questions on the material presented. Video files of the presentations are posted on SRNL's web page at http://srnl.doe.gov/techex_2010/.

SRNL's Christine Langton discusses the development of grout for reactor deactivation and decommissioning during the poster session.

New Grout Developed by SRNL Scientists for SRS Reactor Closure

A combination of teamwork and cutting-edge science is responsible for the unique flowable and self-leveling cement slurry that completely filled the P Reactor vessel at the Savannah River Site (SRS) on Nov. 22, 2010. "The aggressive deactivation and decommissioning schedule required a multidisciplinary approach involving our national laboratory's world-class expertise and innovation," said Dr. David Moody, DOE's Savannah River Operations Office Manager. "This important Recovery Act closure project is providing a final end state for a Cold War production reactor that served the Nation. The *in-situ,* or in-place, deactivation and decommissioning of the SRS P and R Reactors is precedent-setting in the nuclear industry."

Dr. Christine Langton, SRNL advisory scientist on the project, said "the P Reactor vessel grout, a calcium sulfo-aluminate cement, differs from standard Portland cement used in roads, sidewalks, etc. in that it is a less basic material, making it chemically compatible with the hundreds of aluminum sleeve housings in the reactor vessel. Traditional grout with a higher pH would cause the housings to corrode."

"Equally important in the grout design was a requirement for the grout to flow through the constrictive vessel configuration dictated by the former sleeve housings. We addressed these unique challenges by designing the grout to be flowable, self-leveling, non-segregating, and chemically compatible with the reactor vessel materials," Langton said.

> Benefits of this new approach to reactor deactivation and decommissioning include tremendous cost savings due to the *in-situ* approach, which also meets the Presidential Order on sustainability with reduction in greenhouse gases.

One hundred and twenty cubic yards of the cement slurry, the approximate volume of a large home swimming pool, was poured into the reactor vessel during a two-day period. The next step in the reactor closure will be to place a concrete cap over the vessel, while also grouting the below-grade portions of the reactor building, sealing all openings and installing multiple sloped roofs.

The SRS R Reactor, which is identical to P Reactor in size and appearance, but has stainless steel fuel housings, will be filled with another unique grout designed by SRNL.

P Reactor at the Savannah River Site.

The membrane interface probe (MIP) characterizes mercury in the subsurface at the Oak Ridge Y-12 Site.

Applied Field Research Centers Support Groundwater and Soil R&D

OTID's Office of Groundwater and Soil Remediation has established three Applied Field Research Centers (FRCs) to promote demonstration of innovative technologies and new approaches for characterization and remediation of contaminants at DOE sites. The three FRC's include:

1. Attenuation-Based Remedies for the Subsurface, focusing on radionuclides in groundwater at SRS
2. The Deep Vadose Zone, focusing on radionuclides in the unsaturated zone at Hanford
3. Remediation of Mercury and Industrial Contaminants in Streams, Soils, and Groundwater at Oak Ridge.

At an FRC, researchers from the applied and basic science worlds can collaborate on DOE's most challenging problems. They can leverage resources from OTID applied research, Office of Science basic research, and industry and can combine their creativity to develop new tools and further scientific understanding, which can be used by technical assistance teams working across the DOE complex.

Attenuation-Based Remedies for the Subsurface at SRS

Groundwater plumes contaminated with metals and radionuclides are present at numerous DOE sites. The SRS F-Area is being used as a research site to investigate natural and induced methods of contaminant stabilization. At F-Area, recent push-pull tests were focused on understanding how well uranium is bound to the aquifer sediments. The push-pull test involves injection of a solution into a well, time for it to react, and then extraction of water from the well for chemical analysis. The difference between the chemistries of the initial and the extracted fluids provides information on chemical and microbial reactions that have occurred in the aquifer.

Field-based analytical methods were used during the F-Area push-pull testing designed to improve understanding of uranium sorption in the aquifer at SRS, South Carolina.

Deep Vadose Zone at Hanford: Geophysical Monitoring of Remediation Performance

At many DOE sites where the depth to groundwater is significant, radionuclides disposed at or near the surface have migrated to great depths within the soil column, but have not yet reached the groundwater. Methods to stabilize these constituents to slow their downward migration to groundwater are the focus of this research. As part of a Deep Vadose Zone Treatability Test at the BC Cribs and Trenches at the Hanford Site, field testing of desiccation in combination with a surface barrier to immobilize technetium in the vadose zone is underway. Three-dimensional cross-borehole geophysical monitoring of the progress of the desicccation is also being conducted as a collaborative effort between OTID and the Office of Science, through staff from Pacific Northwest National Laboratory and Lawrence Berkeley National Laboratory.

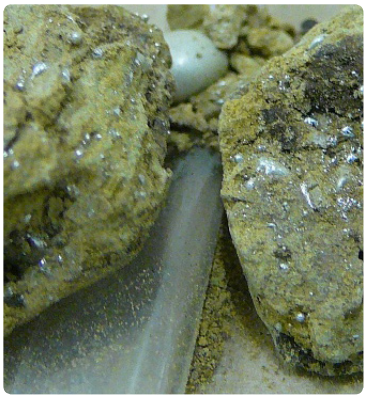
Remediation of Mercury and Industrial Contaminants at Oak Ridge

The Oak Ridge Y-12 National Security Complex lost an estimated 240,000 pounds of mercury to soils, sediments, storm sewers, stream beds, and old process buildings during the facility operations. Due to uncertainties associated with the large number of sources of mercury and unknowns about its transport and ultimate fate, a robust research program is underway to meet the challenges and develop cost-effective solutions. Last year, scientists from two national laboratories demonstrated new methods to:

1. treat water (stannous chloride-based treatment coupled with air stripping and sorption)
2. characterize depth-discrete subsurface elemental mercury in soil and groundwater (membrane interface probe and commercial Geoprobe)
3. sample gas to identify source zones, and
4. determine mercury speciation in soil.

These studies produced significant advances in understanding mercury behavior and extent, which was incorporated into a new conceptual site model to succinctly present complex hydrological, geochemical, and physical interactions controlling mercury mass balance and migration.

Geophysical monitoring of the progress of desiccation to immobilize radionuclides in the vadose zone, BC Cribs and Trenches, Hanford.



Mercury beads are visible in soil cores collected from 15 ft deep at the Y-12 National Security Complex.

OTID Actively Pursues International Collaboration

In 2010, the International Program was actively collaborating with nuclear experts from around the world. The following are a few examples of recent activities:

- In December 2010, a French Congressional Delegation, led by Congressman Grall, a member of the National Defence and Armed Forces Committee of the French National Assembly, met with EM Headquarters and SRS/SRNL staff. The Delegation discussed priorities, difficulties, public acceptance, possibilities of reconversion, and final objectives of their EM program, which involves similar clean-up and dismantlement of facilities and equipment at previous nuclear production sites (Marcoule and Pierrelatte).
- The 7th Standing Committee Meeting between US DOE and the United Kingdom's (UK) Nuclear Decommissioning Authority (NDA) was held in Sellafield, UK in October to review progress and identify further areas of collaboration under the current Statement of Intent between the organizations. Following discussions, the US group toured a number of facilities at Sellafield. Additional meetings were held with members of the Executive Team of Sellafield Ltd. and senior representatives of the UK National Nuclear Laboratory.

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- In October, EM participated at the *AtomEco 2010 Conference and International Atomic Energy Agency (IAEA) Workshop* in Moscow, Russia. The US EM delegation met with Rosatom's Khoplin Radium Institute and Saint Petersburg Electrotechnical University to discuss further collaboration opportunities in the areas of waste management, soil and groundwater remediation, nuclear materials management, and deactivation and decommissioning of nuclear facilities.

US/UK Technology Development Working Group.

Workshop Promotes International Collaboration on Used Nuclear Fuel and High-Level Waste Management

An international workshop hosted by the OTID Office of Nuclear Materials Disposition, in collaboration with the National Spent Nuclear Fuel Program and the UK NDA, provided a forum for discussion of scientific, technical, regulatory, and programmatic aspects of the "back end" of the nuclear fuel cycle.

More than 100 people attended the *Technology Innovation and International Partnership Workshop on Used Nuclear Fuel and High-Level Waste Management* held Sept. 14-16, 2010 in Washington, DC. The primary purpose of the workshop was to integrate, collaborate, and establish communication among many DOE programs [i.e., Office of Science, Office of Nuclear Energy, EM, National Nuclear Security Administration (NNSA)]; DOE Field Offices and National Laboratories; and international partners to develop more cost-effective and efficient technologies for disposition of used nuclear fuel and high-level waste.

Keynote speaker Joyce Connery, Senior Advisor to Deputy Secretary of Energy Daniel Poneman, focused on US needs to decrease the number of nuclear weapons as we increase the use of peaceful nuclear energy. She indicated the US has called for an international effort to secure all weapons with leaders from 47 countries. She spoke about the creation of the Blue Ribbon Commission for America's Nuclear Future (BRC) to produce recommendations for a nuclear waste disposal alternative to Yucca Mountain. Tim Frazier, DOE representative to the BRC, provided an update of their activities and indicated they will issue a draft report in the summer of 2011.

Representatives of the US DOE, the UK, Canada, Australia, and India provided updates on their countries' nuclear programs, their plans for future R&D activities, and plans for final disposition of used nuclear fuel and high-level waste. NNSA also presented their work under the Global Threat Reduction Initiative, including the Foreign Research Reactor Fuel Acceptance Program.

Finally, the Workshop focused on identifying potential collaboration opportunities between US DOE/EM and UK NDA. Four teams of experts committed to determine needs for information exchange and identify collaborative near-term and long-term activities in the following areas: (1) Non-Standard Used Fuels; (2) Aging Management; (3) Drying and Dry Storage Facilities; and (4) Plutonium Storage and Surveillance.

Joyce Connery, Senior Advisor to Deputy Secretary Daniel Poneman, addresses the workshop audience.

The workshop agenda, presentations, summary, and photos from the workshop are available at http://nsnfp.inel.gov/program/.

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